



Armed Forces College of Medicine AFCM



Cardiac cycle

INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

- 1. Describe the changes that occur in atrial volume and pressure, ventricular volume and pressure, heart valve, aortic pressure in each phase of the cardiac cycle.**
- 2. Describe the aortic pulse curve.**
- 3. Describe and draw the jugular venous pressure.**
- 4. Describe the normal heart sounds.**
- 5. Apply the information studied in this section to solve a clinical problem or explain a condition**

Cardiac Cycle

The period of time during which the heart completes one contraction (systole**) and relaxation (**diastole**)**

It is initiated by the P wave of the ECG. Therefore, cardiac cycle can be defined as the period between two successive P waves.

The duration of the cardiac cycle varies according to the heart rate:

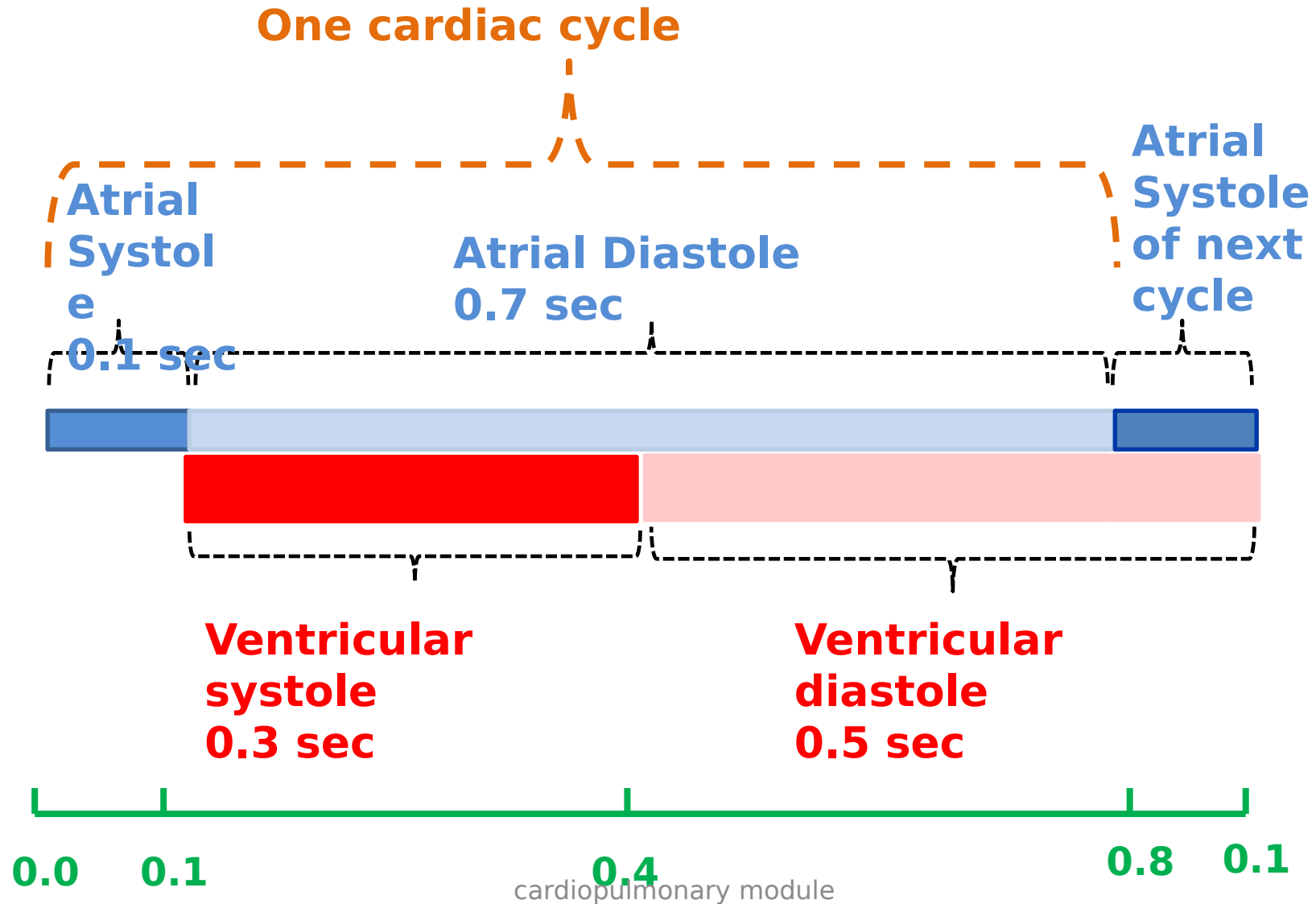
For

example:

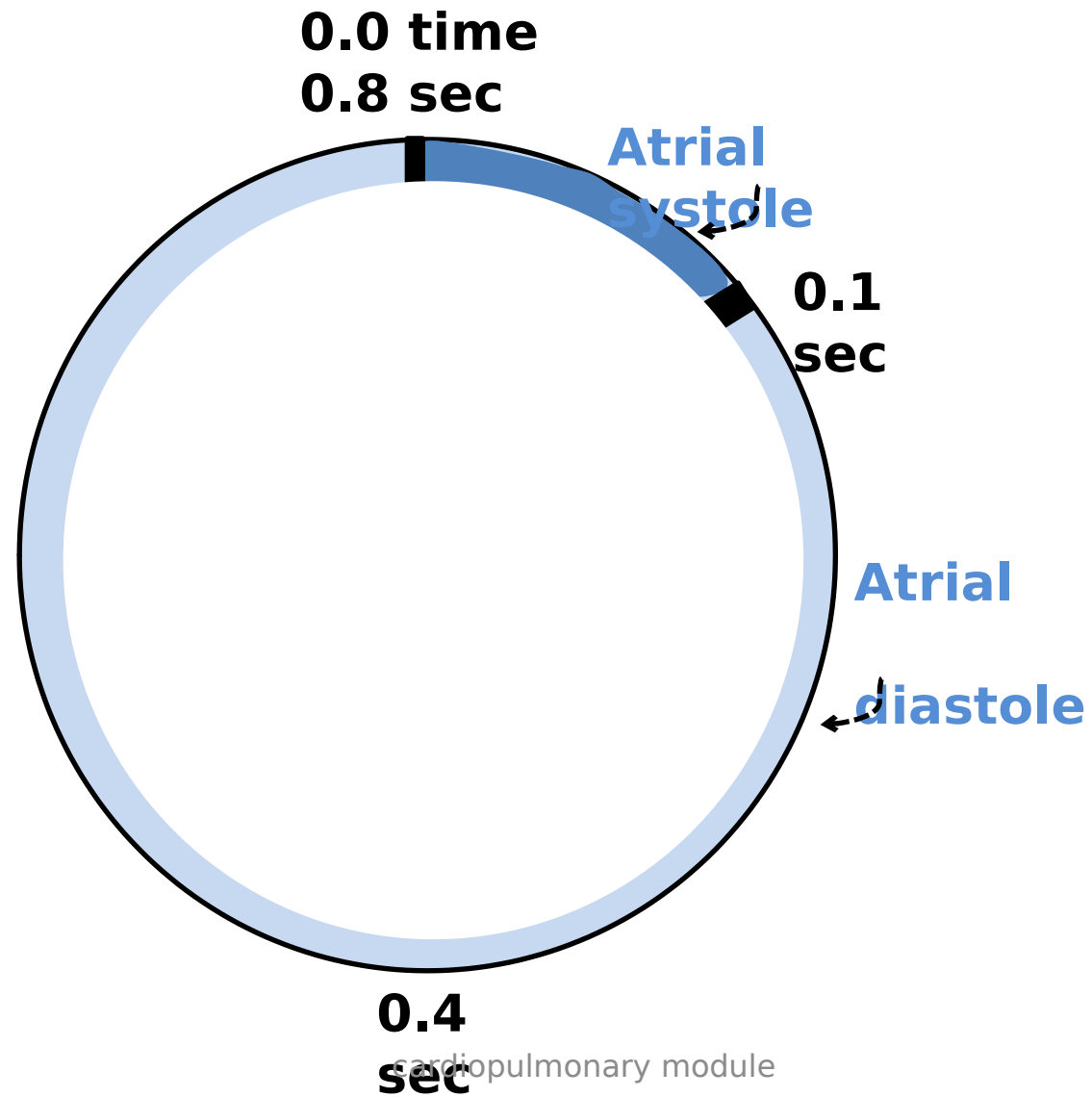
If the heart rate is 75 / minute

Duration of cardiac cycle = $60 / 75 = 0.8$ sec

Cardiac Cycle



Cardiac Cycle



Increasing heart rate shortens the duration of cardiac cycle

	Heart rate 75 / min	Heart rate 200 / min
Duration of cardiac cycle	0.8	0.3

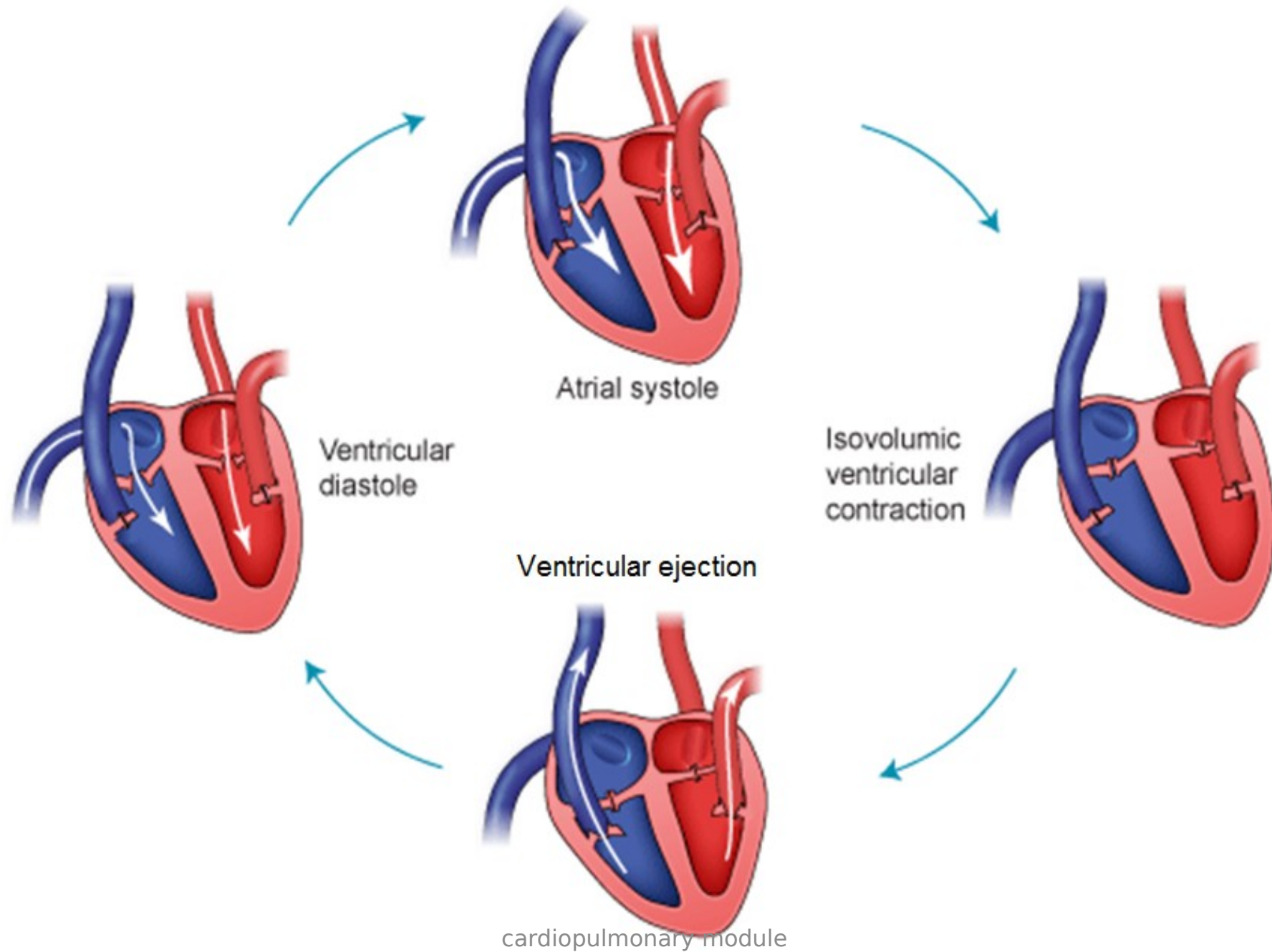
It shortens diastole more than it shortens systole

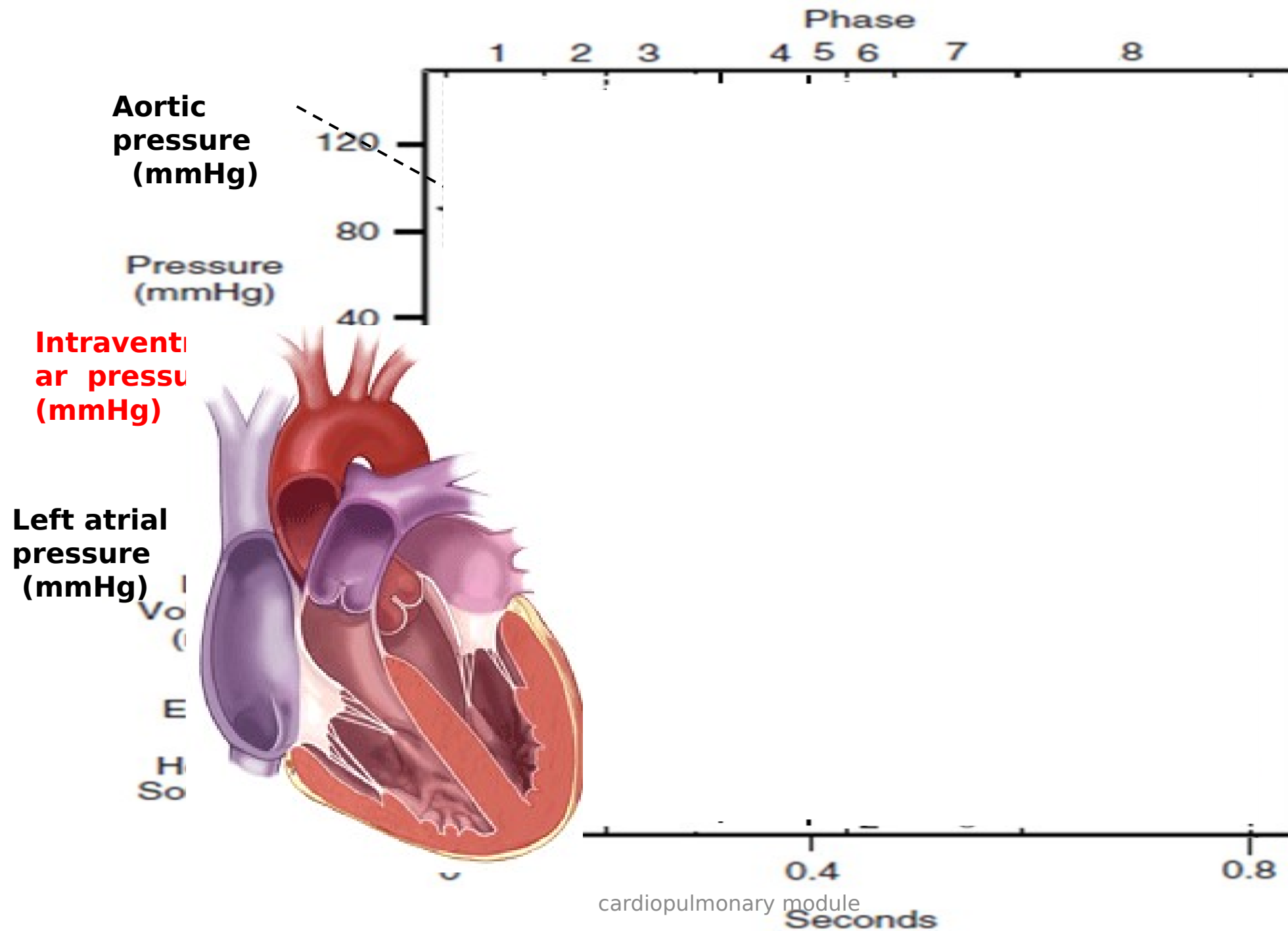
Fast contraction and faster relaxation

Cardiac cycle is divided into **phases**

During each phase, we record changes that occur in the following:

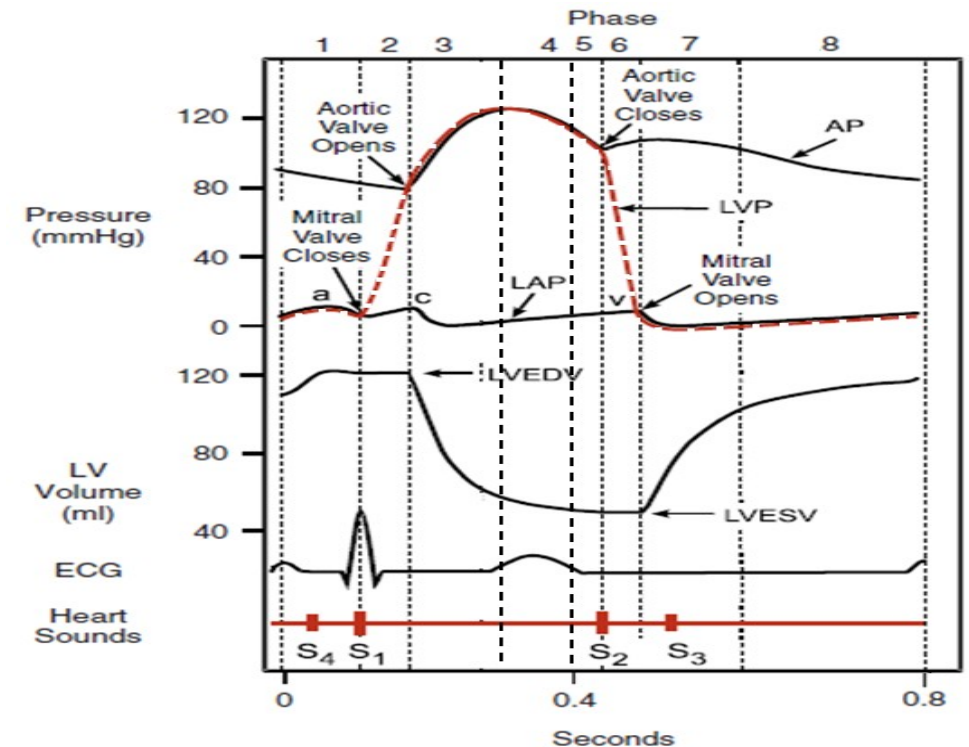
- 1- **Duration** of each phase.**
- 2- **Ventricular pressure**.**
- 3- **Arterial pressure****
- 4- **Atrial pressure**.**
- 5- State of AV and semilunar **valves**.**
- 6- Ventricular **volume**.**
- 7- **ECG** waves.**
- 8- Heart **sounds**.**



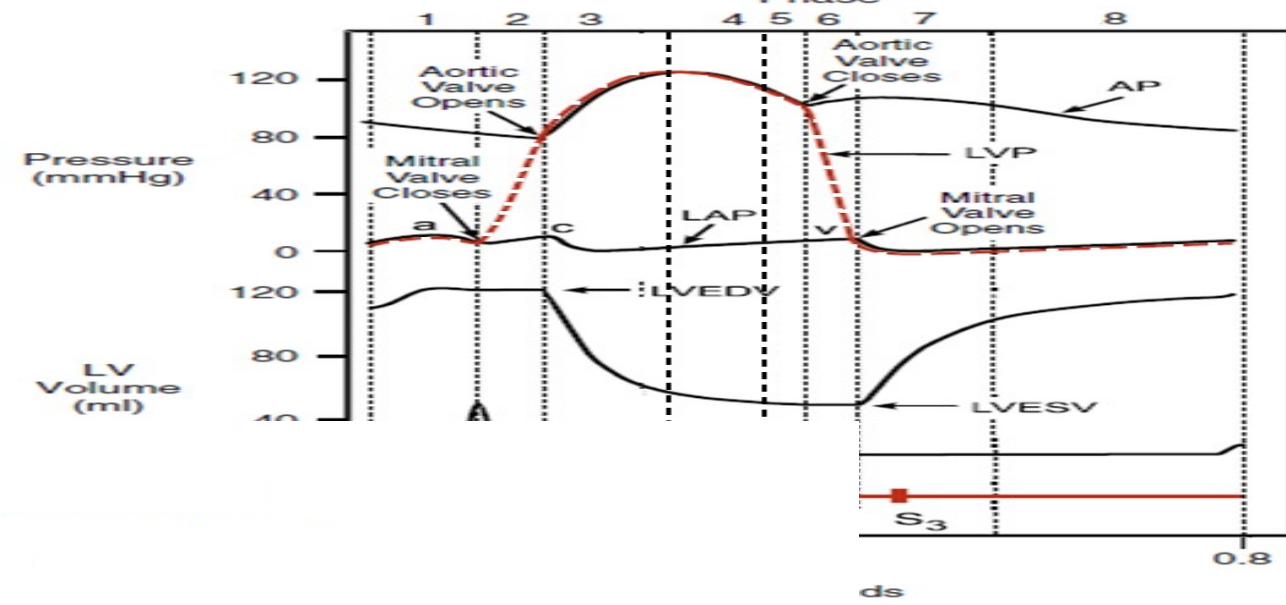




1. Atrial contraction
2. Isovolumetric contraction
3. Maximum Ejection (rapid ejection)
4. Reduced ejection
5. Protodiastolic
6. Isovolumetric relaxation
7. Maximum filling (rapid filling)
8. Reduced filling



Aortic Pressure Curve



Aortic Pressure Curve



Aortic Pressure Curve



cardiopulmonary module

- Arterial pulse wave:

This is similar in shape and causes to aortic pressure curve and can be recorded from a superficial artery as radial artery.

- Radial pulse wave helps to know:

1- heart rate

2- rhythm

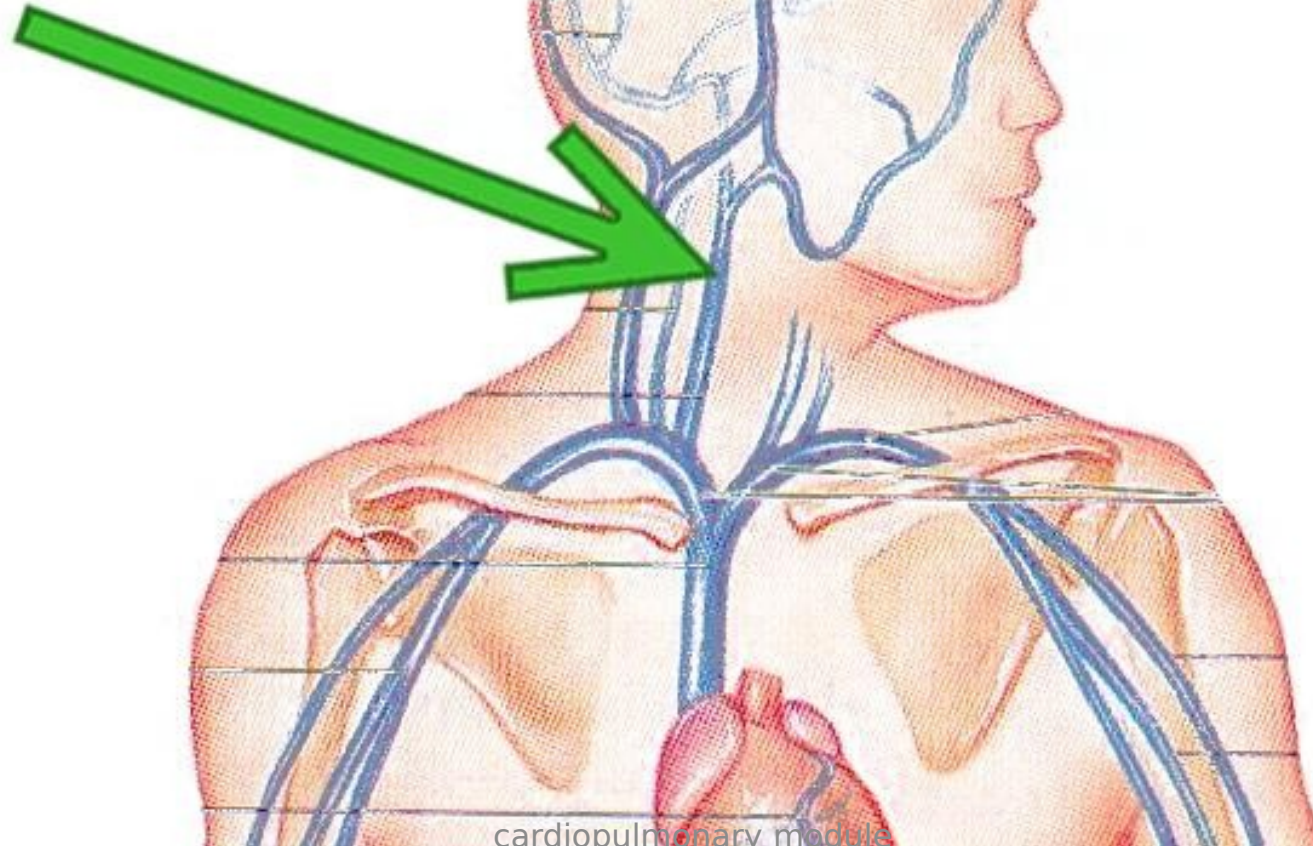
3- force of contraction

4- by palpation, state of arterial wall can be felt

Right Atrial Pressure Curve

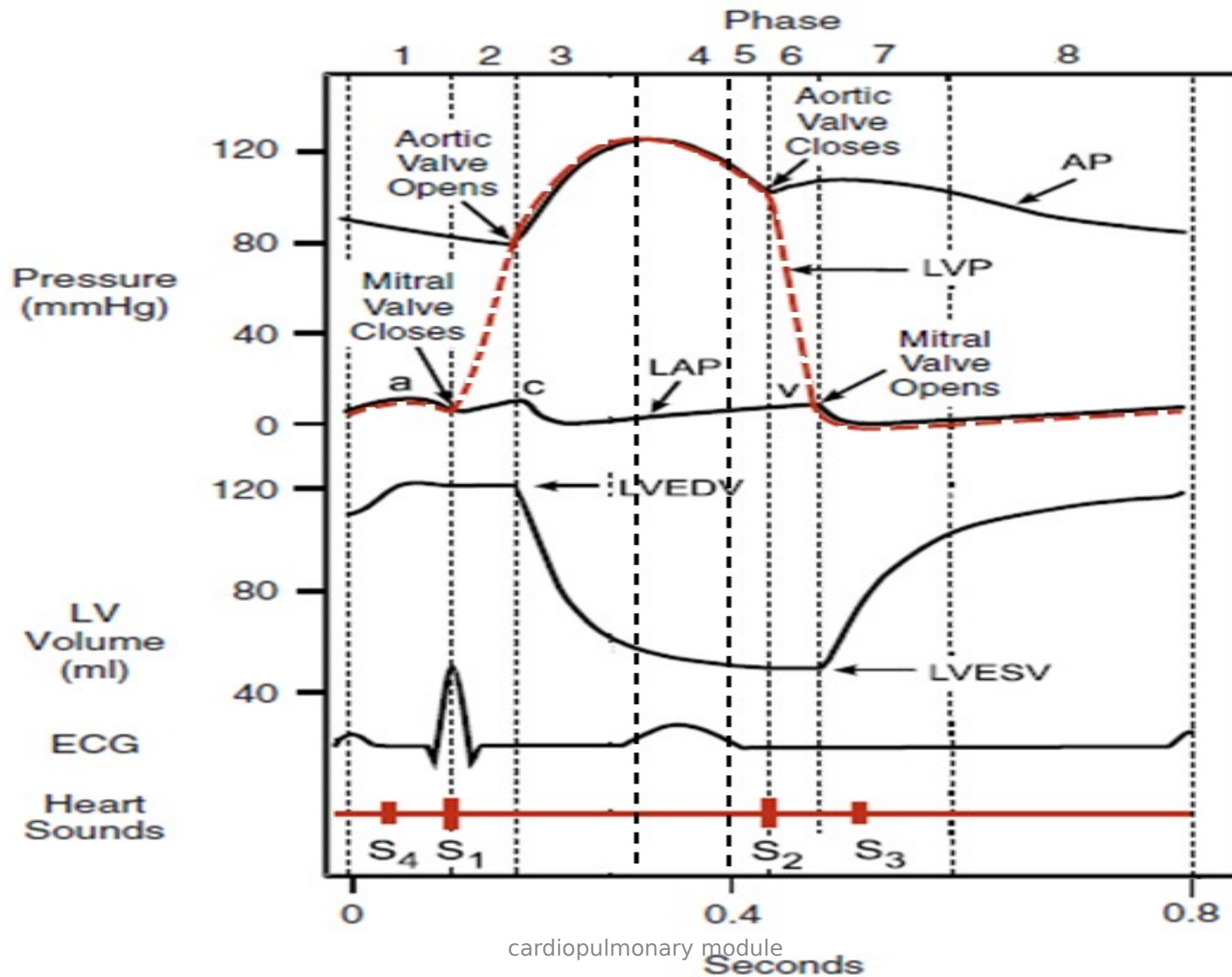
Jugular Venous Pulse JVP

Jugular Vein









Right Atrial Pressure Curve

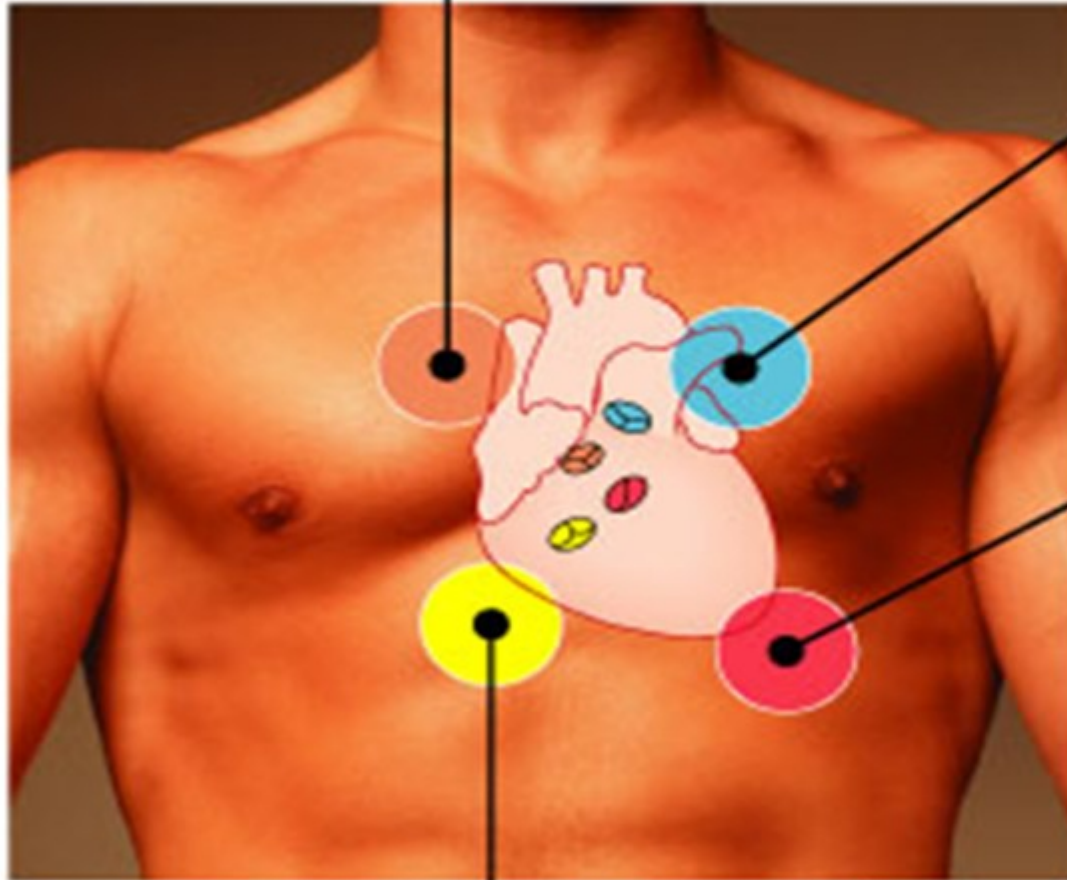
Jugular Venous Pulse JVP

Aortic component of
second heart sound

Pulmonary component
of second heart sound

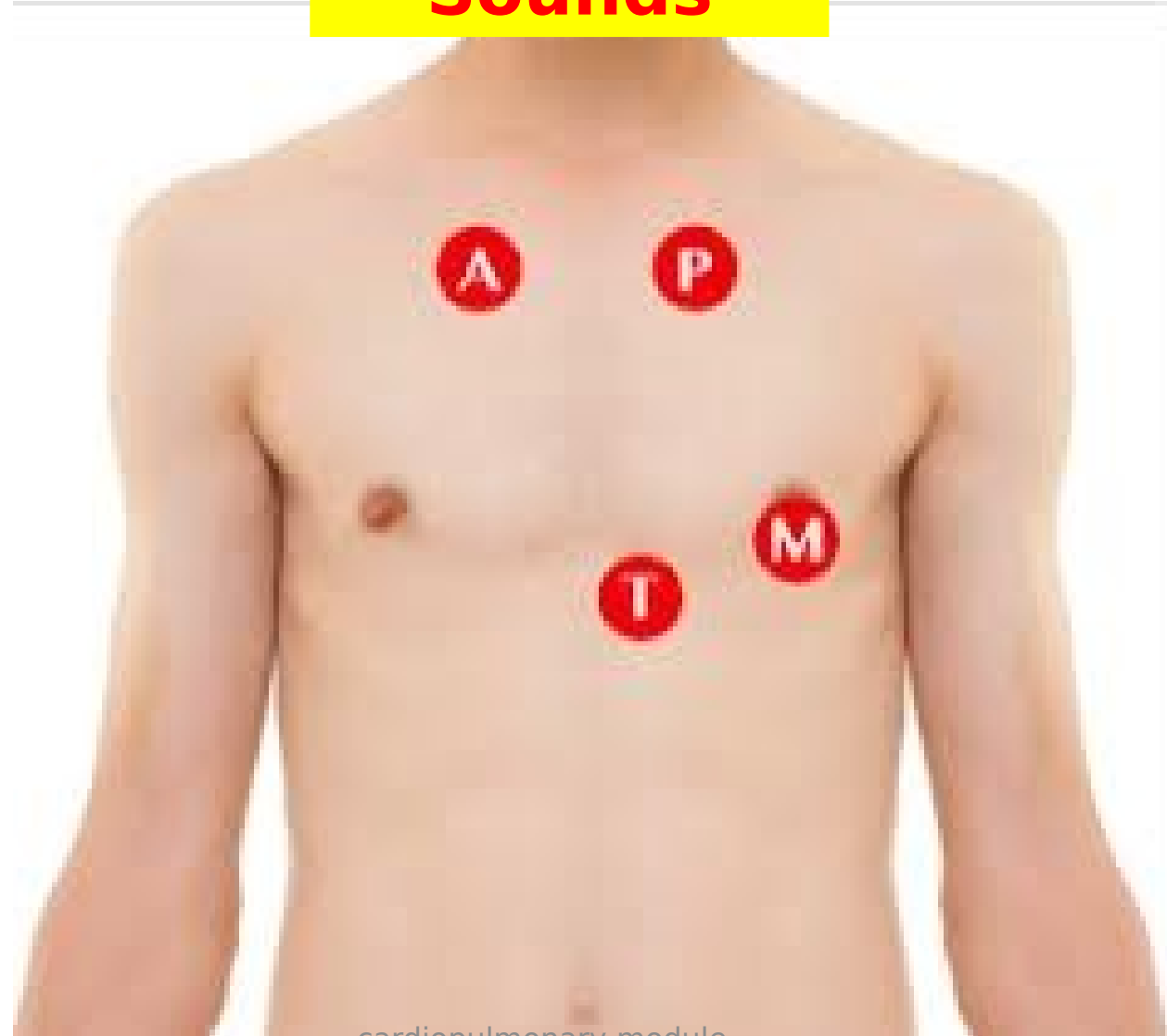
Mitral component of
first heart sound

Tricuspid component
of first heart sound



sternum

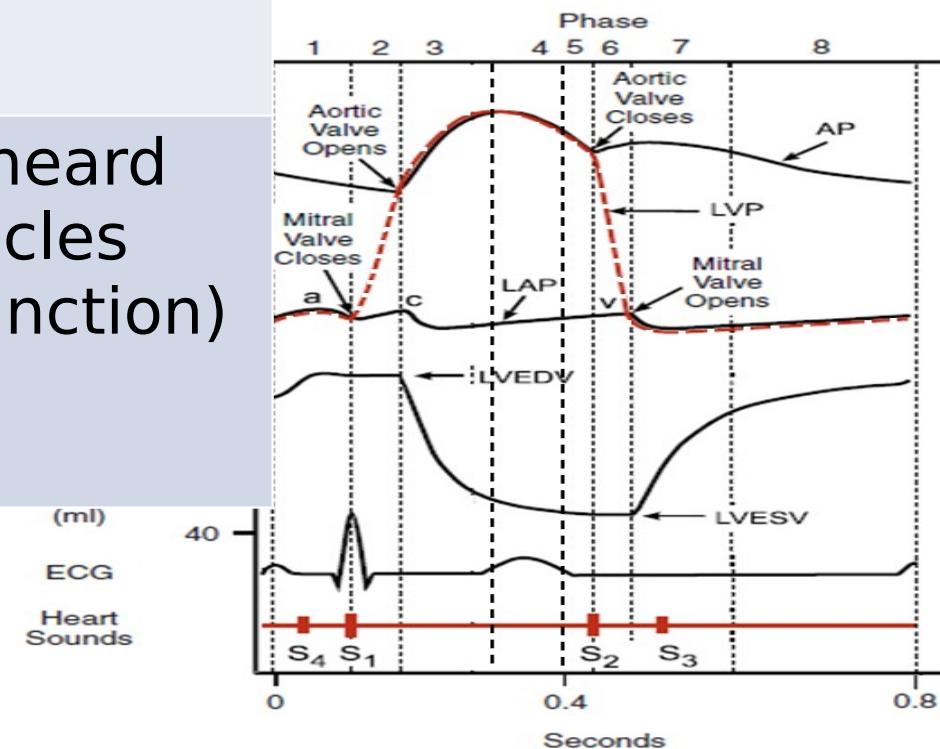
Heart Sounds



cardiopulmonary module



	S3	S4
Causes	Rush of blood during rapid ventricular filling	Vibration produced by contraction of atrial muscle
Timing	Rapid filling phase (just after S2)	Atrial systole (just before S1)
Associated conditions	Normal in children Pathologically heard with heart failure and dilated cardiomyopathy	Pathologically heard with stiff ventricles (diastolic dysfunction)





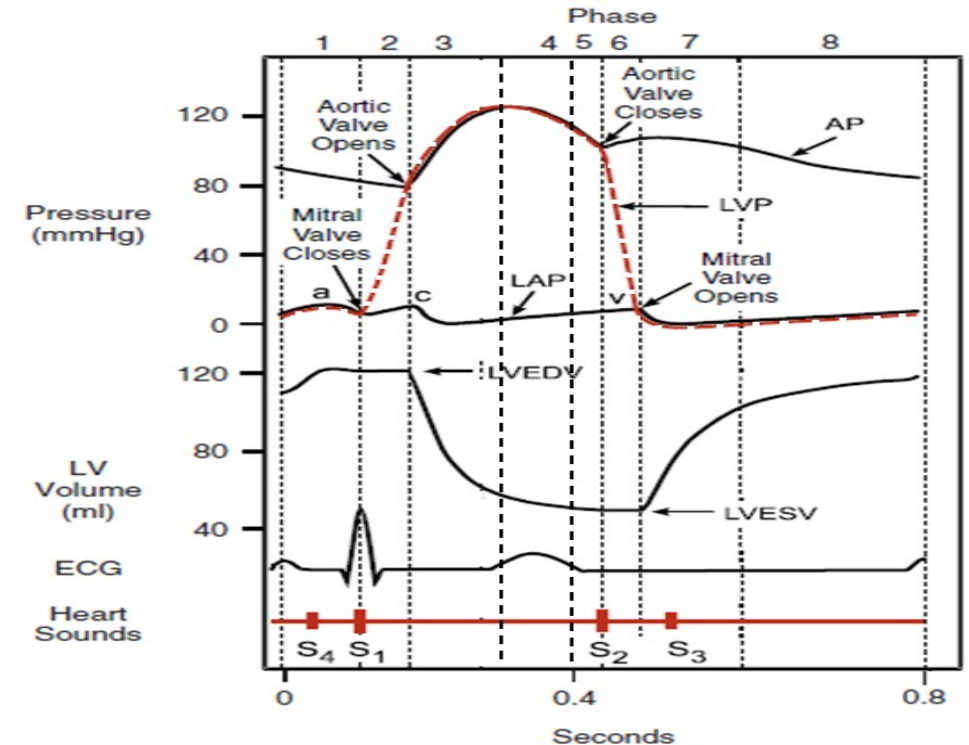
QUIZ TIME!

Test your knowledge



(1) Which of the following is the ECG wave that matches the isovolumetric contraction phase?

- a) P wave
- b) QRS complex**
- c) ST segment
- d) T wave

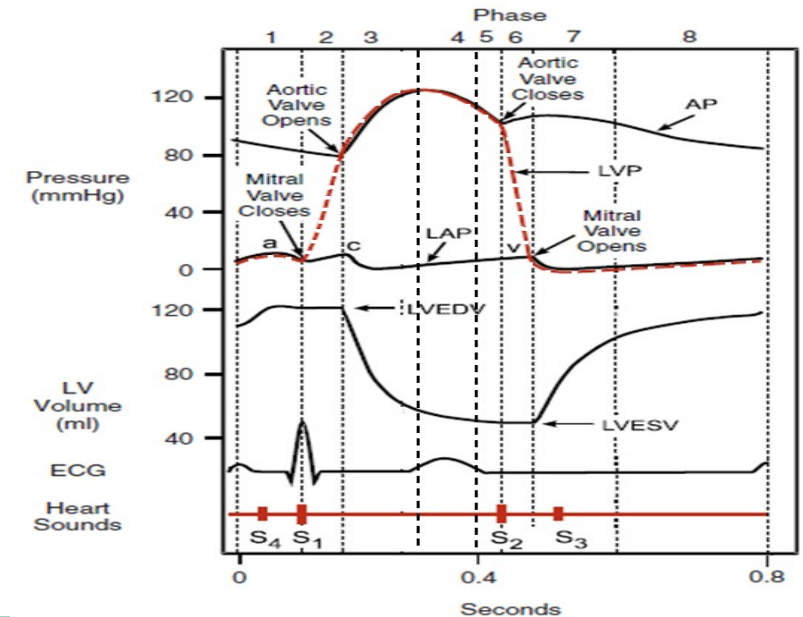


Test your knowledge



(2) Which of the following phases shows the highest intraventricular pressure?

- a) End of isovolumetric contraction phase
- b) Start of atrial contraction phase
- c) Start of maximum filling phase
- d) End of rapid ejection phase**
- e) End of reduced ejection phase

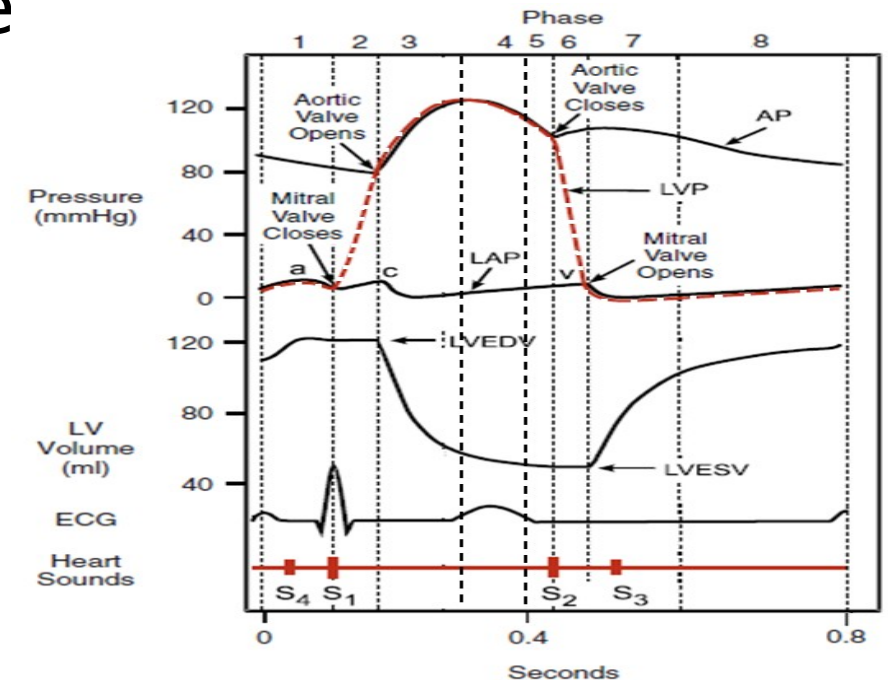


Test your knowledge



(3) Which of the following phases matches with S3?

- a) Isovolumetric contraction phase
- b) Atrial contraction phase
- c) Maximum filling phase**
- d) Rapid ejection phase
- e) Reduced ejection phase

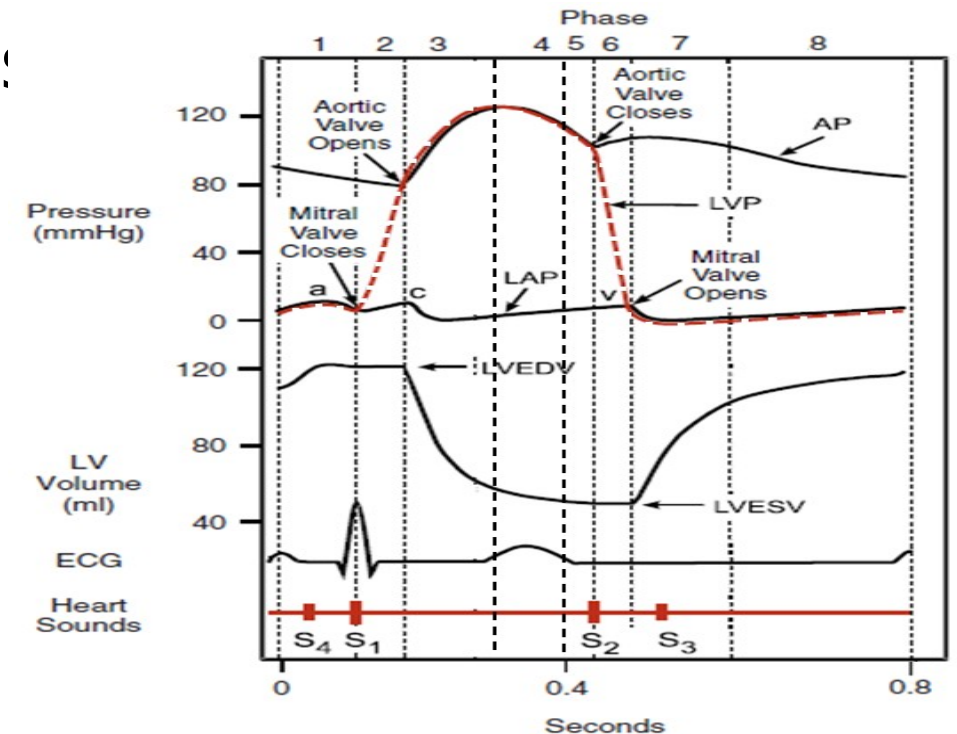


Test your knowledge



(4) Which of the following phases coincides with the dicrotic notch of aortic pressure curve?

- a) Isovolumetric contraction phase
- b) Atrial contraction phase
- c) Maximum filling phase
- d) Protodiastolic phase**
- e) Reduced ejection phase

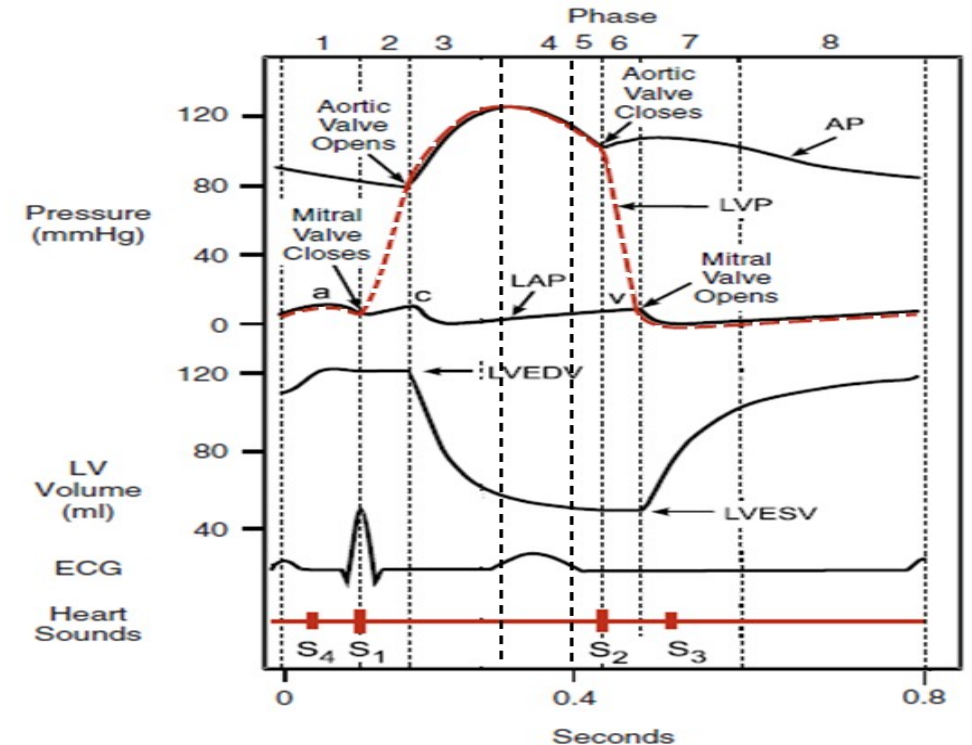


Test your knowledge



(5) Which of the following is the right wave of jugular venous pressure curve at the isovolumetric contraction phase?

- a) C-wave
- b) V-wave
- c) Dicrotic notch
- d) X limb
- e) a-wave



References



- John E. Hall. (2015): Guyton and Hall Textbook of Medical Physiology, 13th Edition. Elsevier Health Sciences.
- Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwyn Brooks. (2015): Ganong's Review of Medical Physiology ,25th Edition. McGraw Hill Professional.



*Thank
you*

